

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC**

In the Matter of

Unlicensed Operation in the TV Broadcast Bands

ET Docket No. 04-186

Additional Spectrum for Unlicensed Devices
Below 900 MHz and in the 3 GHz Band

ET Docket No. 02-380

**Comments of WirelessUnleashed
(Kevin Werbach, David Isenberg, Clay Shirky, and Andrew Odlyzko)**

Introduction

The Commission should move forward with its proposal to allow unlicensed devices to operate in wireless frequency bands currently allocated to broadcast television. Doing so would free up un-used capacity for innovative new wireless applications. It would encourage competition. It would spur industry investment in new technologies. It would catalyze deployment of devices that make more efficient use of the wireless spectrum. And it would serve as a model for other governments worldwide.

The Commission's approach represents a sound and conservative framework for unlocking un-used wireless capacity. Reasonable technical rules can ensure that existing services are protected, even as new devices are allowed to operate on an unlicensed basis. We urge the Commission, however, to build flexibility into those rules. Some of the technical mechanisms suggested in the Notice of Proposed Rulemaking raise the

possibility of locking in inefficient or outmoded technologies. The Commission should create incentives for the private sector to develop effective and efficient solutions to concerns about incumbent services. Otherwise, it runs the risk of killing the economic viability of the very devices it seeks to allow. The Commission should also take into account environments, such as rural areas and low-power transmission within the home, where substantially looser regulation may be possible than in outdoor urban settings.

WirelessUnleashed is a project of leading technology analysts who have come together to advocate freeing up additional low-frequency capacity for unlicensed wireless systems.

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WirelessUnleashed is an umbrella for our joint educational and advocacy efforts related to wireless policy. We have in the past received funding support for our efforts from Microsoft, which shares our goal of opening up wireless capacity for new applications and services around the world.¹ However, all views expressed here are our own. Microsoft neither dictates nor edits the content of our writings. Though we share common goals with regard to wireless capacity, we do not necessarily endorse all of Microsoft's positions.

I. General Comments

We commend the FCC for taking the next step in this proceeding and adopting a notice of proposed rulemaking.² Comments in the Notice of Inquiry phase³ demonstrated strong technical and business support for opening up “white space” below 1 GHz for unlicensed use. Though incumbent broadcasters and wireless carriers raised basic objections, the Commission rightfully rejected them in the NPRM. It is appropriate and desirable for the Commission to consider the impacts of its actions on incumbents. In the end, however, the Commission should base its decisions on sound technical analysis and its mandate to serve the public interest.

The potential benefits of the Commission’s proposal are compelling. Freeing up wireless capacity in the bands now allocated to broadcasting could improve broadband connections to the home, and spark deployment of peer-to-peer or location-based wireless applications. It could facilitate deployment of advanced communications services in rural areas. And it could create conditions for further investment and innovation across the telecommunications and information technology sectors.

¹ See, e.g., *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, Reply Comments of Microsoft (May 16, 2003).

² *Unlicensed Operation in the TV Broadcast Bands*, ET Docket No. 04-186, Notice of Proposed Rulemaking (rel. May 25, 2004) (“NPRM”).

³ *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, 17 FCC Rcd. 25,632 (2002).

In addition to these very real developments, the symbolic value of such action would be enormous. Since the adoption of the 1927 Federal Radio Act, which created the precursor to the FCC, government regulators have seen their task as managing use of the wireless spectrum in order to allocate uses and prevent interference. Such an approach arguably made sense early in the last century, given the early state of radio technology. Increasingly, however, pervasive “command-and-control” regulation of wireless communication has the perverse effects of limiting capacity and frustrating market incentives for competition and efficiency. The proposals detailed in the NPRM represent a different vision. Instead of relying on outmoded central planning concepts, the Commission should see its primary mission as maximizing wireless capacity.⁴

There are no such things as “broadcast bands.” The laws of physics do not assign a particular function to specific radio frequencies. The frequencies used for broadcast television could easily have been assigned to another service; in fact, some of the same frequencies are used elsewhere for mobile phone networks. After the completion of the digital television transition, many of the so-called “broadcast bands” are to be returned to the federal government, potentially for reassignment to other uses.

The distinction is more than semantic. Broadcasters have licenses to operate where they do, and legitimate expectations that their service not be unreasonably degraded. What they do not have is guaranteed control over all uses of 400 MHz of prime spectrum. The NPRM takes an important step forward in this regard. If unlicensed devices can operate in frequencies currently designated for broadcasting without causing harmful interference, the effective result is new usable capacity where none existed before. Even if the “white spaces” are not appropriate for additional broadcast licenses, as traditionally defined, that should not prevent the capacity from being used for other purposes that would serve the public interest.

⁴ For a more detailed explication of this fundamental shift, see Kevin Werbach, *Supercommons: Toward a Unified Theory of Wireless Communication*, 82 Texas L. Rev. 863 (2004); Kevin Werbach, *Radio Revolution: The Coming Age of Unlicensed Wireless* (New America Foundation and Public Knowledge working paper, December 2003)

The rapid increase in wireless devices, applications, and services will make it imperative for the FCC and its counterparts elsewhere to be creative in expanding usable capacity. The unexpected success of WiFi “hotspots,” and the growth of the mobile phone market (now serving over 150 million Americans and over 1 billion subscribers worldwide) demonstrate the powerful effects of market forces, once unleashed.

Ultimately, the Commission’s goal should be to extricate itself from the task of allocating and assigning spectrum. That means continuing to expand the opportunities for unlicensed access. Mechanisms that allow equipment vendors, service providers, and users to dynamically access wireless capacity for a multitude of uses will be more efficient than any government assignment. This NPRM is a step in the right direction.

II. The Need for Additional Unlicensed Capacity

We agree with the Commission’s statement in the NPRM that it is desirable to provide additional spectrum for unlicensed devices.⁵ As commenters in the NOI phase noted,⁶ growth in the market around WiFi local area networks in the unlicensed 2.4 GHz and 5 GHz bands has been nothing short of spectacular. WiFi is a global success story, spurring a virtuous cycle of innovation and investment. Equipment manufactures and others are looking to repeat that success story with other technologies, including WiMax (IEEE 802.16) for unlicensed metropolitan-area networks, and short-range systems employing ultra-wideband or other mechanisms.

Unlicensed use of wireless capacity is structurally different than exclusive allocations. The start-up costs of a broadcast or cellular network are concentrated in centralized infrastructure. Most of the money is spent acquiring spectrum rights, acquiring

⁵ See NPRM at 4.

⁶ See, e.g., *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, comments of Intel, at. 5 (“Intel comments”); *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, Comments of New America Foundation, et al.

programming, and constructing towers. Users cannot take advantage of the capability to communicate until the network operator launches its service. And once it does, the users must purchase devices that conform to the network owner's technical requirements. The network owner determines which equipment vendors can build those devices, and sometimes itself serves as the exclusive distributor of devices.

With an unlicensed system, like WiFi, most costs are capitalized through user purchases of equipment.⁷ Users need not wait for a central tower to begin enjoying the benefits of their purchases. Service providers can thus take advantage of a market which itself provides a great deal of the seed capital to reach critical mass. More usage and new applications increase the value of the network for everyone. Thus, having a WiFi card in a laptop is much more valuable today than it was four years ago, even though the price has dropped, because there are so many places to use it and things to do with it.

In other words, there is not an "unlicensed" industry competing for spectrum in the same sense as there is a broadcast television industry and a cellular telephone industry.

Unlicensed allocations may benefit certain companies, such as those who manufacture the relevant devices. However, these companies cannot dictate what is deployed in the relevant spectrum, nor can they dictate what services users enjoy. Within the bounds of the FCC-mandated technical parameters, the spectrum is open to competition. Users themselves determine what gets deployed, based on what they are willing to buy.

Government-defined spectrum allocations prevent non-approved use of certain wireless devices, in effect creating artificial scarcity. Allowing market forces in the device and service markets to determine what is deployed creates beneficial incentives to increase capacity. Manufacturers want to sell more devices. Since they cannot hide behind government-backed protection against other users, they must make their own devices as

⁷ For a detailed analysis of the structural differences between licensed and unlicensed systems, see *Some Economics of Wireless Communications*, 16 HARV. J.L. & TECH. 25 (2002); Yochai Benkler, *Overcoming Agoraphobia: Building the Commons of the Digitally Networked Environment*, 11 HARV. J.L. & TECH. 287 (1998);

robust as possible. That robustness reduces the sensitivity of devices to one another, mitigating “harmful interference.”

We recognize that the FCC has taken other steps in recent years to increase the available wireless capacity for unlicensed devices. The FCC adopted a Spectrum Task Force report that promoted expanded use of the “commons” mechanism for wireless policy.⁸ The Commission allocated an additional 255 MHz for unlicensed devices in the 5 GHz band, and has supported global availability of that capacity through the World Radio Conference.⁹ The Commission has also approved initial deployment of ultra-wideband, an exceptionally promising technology that can “underlay” existing licensed frequencies.¹⁰ The Commission has modified or sought comment on several of its technical rules governing techniques such as spread-spectrum transmission and software-defined radios, in order to remove outmoded impediments to technological progress.

These efforts to expand opportunities for unlicensed operation have proven extremely successful in spurring innovation, investment, new service offerings, and competition. In many ways, they have been more successful than higher-profile recent efforts to auction new licensed spectrum or to create property rights in spectrum. Though the Commission should continue to explore multiple avenues for achieving its spectrum policy goals, it should redouble its efforts on the unlicensed front.

In other words, more can and should be done. The appropriate question is not, “how much is enough?” but, “what approach in each situation will best achieve the FCC’s public-interest objectives?” One size does not fit all. Top-down allocation for particular uses should still have a place in the FCC’s spectrum management quiver. So should mechanisms to allow market transactions around spectrum, such as the Commission’s

⁸ Federal Communications Commission, *Spectrum Policy Task Force Report*, ET Docket No. 02-135 (rel. Nov. 15, 2002).

⁹ See Revision of Parts 2 and 15 of the Commission’s Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, ET Docket No. 03-122 (rel. June 4, 2003).

¹⁰ Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission Systems, First Report and Order, 17 F.C.C.R. 7435 (2002).

secondary markets rules. And so should continued efforts to free up capacity for unlicensed use.

One would be hard-pressed to assert that radio technology has reached its endpoint. On the contrary, radio engineering appears poised for a renaissance, as precepts long taken as given are called into question. Broadcast systems continue to employ the same high-power, narrowband transmission methodology they have used for decades, as alternative approaches have gone from concept to lab to reality. By applying techniques and resources from the computing and data-networking worlds, researchers are producing devices and networks with stunning new capabilities. Systems using novel techniques such as mesh networking, smart antennas, orthogonal frequency division multiplexing, space-time coding, and software-defined radio are rapidly moving from the lab to the field.

Given all this innovation, the best way to enhance wireless capacity in the future will be to rely increasingly on technology and market forces. The best way to transition toward this approach from the legacy of government-devised fiefdoms for particular services is to open up available capacity around existing licenses. The frequencies now assigned for broadcasting provide an outstanding example. Technological progress makes it possible for new devices to share frequencies with legacy broadcasters. The FCC should take full advantage of this opportunity.

III. The Value of Opening up Broadcast “White Space”

The NPRM argues that the public interest would be served by allowing operation of unlicensed devices in the bands currently allocated to broadcast television, and that those bands are suitable for such operations.¹¹ We strongly concur with the Commission’s tentative conclusions. Increasing available capacity for unlicensed activities should be a

¹¹ NPRM at 8.

general priority of the Commission's spectrum policies. Opening up the broadcast white space, however, offers particular advantages that should be exploited.

There is a reason why these bands are referred to as the "beachfront property" of spectrum. Frequencies below 1 GHz are the easiest and cheapest place to build systems designed to reach large numbers of people.

If the policy objective is – properly – to open up the most new communications capacity, especially in places where that capacity is lacking, the simplest way to do so is to free up low-frequency spectrum. Using today's mainstream technologies, signals can be received over greater distances, and through greater obstacles, below 1 GHz than at higher frequencies. It is easier to build "non-line-of-sight" systems, for example, in which the receiver cannot visually see the antenna. That is particularly important for metropolitan-area scenarios and broadband to the home. It is also cheaper to build the necessary gear, all things being equal.

One might ask, why do we need more wireless capacity? A similar question could have been raised at the inception of cellular phone service, digital PCS services, the unlicensed 2.4 GHz ISM and 5 GHz U-NII bands, and broadband connections to the home over cable modems and digital subscriber line. Each time, some observers claimed there would never be demand for new capacity. In reality, the FCC underestimated the level of demand in each case. The fact is that user demand for connectivity is insatiable. Individual services may succeed or fail, and demand may take more or less time to ramp up, but there can be no question that the world is becoming increasingly densely connected.

To take just one driver, increasing adoption of broadband and digital rich media will place substantial new demands on data networks. Digital cameras are already outselling film cameras. Some 150 million camera-enabled mobile phones will be sold in 2004, a number expected to hit 500 million annually by 2008, according to several analysts. Most of those cameras will soon handle video as well as still images. With broadband pipes to take advantage of all that personal rich media content, network traffic will grow

significantly. According to Eli Noam of the Columbia Institute for Tele-Information: “A typical narrowband internet user generates about 36 megabytes of bit traffic per month. A broadband user who regularly downloads movies and music, plays interactive games, shares files with peers and uses internet telephony will generate 230 times as much traffic, over 8,000 MB.”¹²

More low-frequency capacity for unlicensed wireless devices would open the door for a plethora of fixed and mobile applications. As the WiFi market has shown, unlicensed spectrum and standards-based equipment create an ecosystem that builds upon itself. Vendors are now building WiFi into home media centers, mobile phones, security cameras, and many other types of devices. Performance, features, and ease of use are increasing, thanks to competitive forces. Matching that vitality with the advantageous propagation characteristics of low-frequency spectrum will have a salutary effect on several markets.

IV. Unlicensed Devices Can Operate in Broadcast “White Space”

Commenters in the NOI phase of this proceeding provided strong technical support for the view that unlicensed devices can coexist with incumbent broadcasters without causing unreasonable degradation of those broadcasters’ services. In particular, Intel and Shared Spectrum offered hard data about the amount of available spectrum in bands allocated to broadcasting.¹³ They also suggested mechanisms that unlicensed devices could use to ensure their transmissions did not impinge on broadcast signals.

¹² Eli Noam, “A Bad Call for Offshoring,” FT.com, May 18 2004, *available at* <http://news.ft.com/servlet/ContentServer?pagename=FT.com/StoryFT/FullStory&c=StoryFT&cid=1084907662615>.

¹³ Intel comments; *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, comments of Shared Spectrum, Inc.

Among the key points these commenters highlighted are:

- Significant numbers of broadcast channels, especially in the UHF range, are not in use. This is true even in dense urban areas.
- Television broadcast towers are static. Their signal properties are well understood. Therefore, building unlicensed devices to protect incumbent broadcasters is a straightforward task.
- Rural areas are likely to have even more “white space” available than urban areas, because of the smaller number of over-the-air broadcast stations in operation. Though this proceeding focuses on the United States, a similar argument applies to many countries in the developing world that could benefit from policies similar to the ones proposed here.
- There are a variety of well-proven techniques, including dynamic frequency selection, dynamic power control, and directional antennas, for mitigating impacts of unlicensed devices on nearby broadcast transmissions. Add to this newer approaches such as cognitive radio, Global Positioning System location sensing, and smart antennas, and the task of ensuring coexistence is eminently feasible.

When it comes to wireless systems, it is easy to engage in hand-waving about what is or is not feasible. Thorough, high-quality technical analysis should be the basis for any decision. In the NOI phase, several commenting parties began the process of building such a technical record. The NPRM phase should offer an opportunity to expand and deepen that record. Though there is a strong basis for concluding that substantial broadcast “white space” exists, the specifics of where, when, and how to exploit it must be the subject of ongoing discussions among industry participants.

However, one general point should be kept in mind. We simply don’t know “how much spectrum” is available at low frequencies for alternate uses. The degree to which devices can coexist depends on a host of factors: the state of technology, what devices and services are currently operating, the geographical location, the range and other characteristics of the new service, etc. Just because, hypothetically, it is not economically feasible to deploy a WiFi-like broadband WLAN service in sub-1 GHz

frequencies in Manhattan, doesn't mean other services, or other locations, couldn't readily be accommodated.

Among the most exciting areas of radio technology research and deployment is mesh networking. Essentially, mesh networking uses receivers as repeaters. Nodes on the network also carry traffic for other nodes. This means that new users add capacity as well as taxing it. It also shortens transmission distances, allowing for lower power operation and greater robustness. Mesh networks seem particularly well-suited for person-to-person applications, in which data flows are idiosyncratic and unpredictable. Such applications may enjoy rapid growth in the coming years, especially for rich media.

A mesh network may be able to operate where a broadcast architecture would create unacceptable degradation of existing devices. Assumptions about what is or is not feasible should be tempered by the recognition that techniques such as mesh networking may open up new opportunities where previously no viable service was possible.

Even the broadcasters themselves, in their comments in this proceeding, acknowledge the potential value of unlocking under-utilized capacity in the spectrum where they currently operate. The joint comments of the Association for Maximum Service Television, National Association of Broadcasters, and Association of Public Television Stations in the Notice of Inquiry phase primarily object to the idea of opening up white space during the ongoing transition to digital television.¹⁴

We commend the broadcasters for recognizing that the public interest is served by making the fullest possible use of wireless capacity. The broadcasters' claim that the Commission should be particularly sensitive during the transition to digital television, through overblown, is nonetheless worthy of ongoing scrutiny. Change poses challenges, but also creates opportunities. And it may well be that, by the time this proceeding

¹⁴ *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, ET Docket No. 02-380, Notice of Inquiry, Joint comments of the Association for Maximum Service Television, National Association of Broadcasters, and Association of Public Television Stations ("broadcaster comments").

concludes, devices are designed and built; and large numbers of unlicensed devices are deployed, broadcasters' concerns about the DTV transition will be moot.

V. Regulatory Framework for Unlicensed Devices

The NPRM seeks comment on the Commission's proposed technical requirements for unlicensed devices that would operate in frequencies allocated to broadcasting. Though we believe the Commission is generally on the right track, we are concerned that the proposals in the NPRM are too rigid, and will create difficulties in the real world.

The NPRM distinguishes among two kinds of unlicensed devices: personal/portable and fixed/access. This is a reasonable distinction on the surface. However, the Commission should be careful not to put too much stock in specific characteristics of devices. A technology designed for fixed environments may migrate to portable uses, or vice versa.¹⁵ What is important is not the device but the usage scenario. Systems that provide connectivity to a stable location, such as a home, involve different issues than systems embedded into portable equipment such as laptops and mobile phones.

The Commission identifies two principles for unlicensed devices operating in the broadcast whitespace:

- Unlicensed devices *need* the ability to determine whether the band is in use before transmitting; and
- Unlicensed devices *may need* the ability to move off a band when a licensed broadcaster begins transmitting there.

At a general level, these criteria are true for any unlicensed device. Because unlicensed devices have no government-enforced protection against other signals, they must take steps to ensure their transmissions are received. With modern systems like WiFi, this

¹⁵ For example, WiMax was originally envisioned as purely a fixed access technology, but work is now underway to develop a mobile version of the standard.

typically involves some manner of dynamic frequency selection or dynamic power selection.

When applying these principles to broadcast whitespace, the devil is in the details. As noted above, what constitutes a band being “in use” is more complex than it seems. A key issue will be how the FCC defines the level of usage that unlicensed devices should “count” as a band being off-limits. Even as it sets such limits, the Commission should strive to make them flexible and changeable as technology provides its own solutions to the challenges of sharing spectrum.

VI. Mechanisms for Avoiding Harmful Interference

The NPRM proposes a series of technical mechanisms to ensure that unlicensed devices do not create unreasonable degradation of broadcast reception. Our greatest concern is that the Commission should not adopt too rigid a set of rules to prevent interference, locking in obsolete or inefficient solutions. The Commission’s inclination to take a conservative approach is reasonable, given the significant value of incumbent broadcast services. Nonetheless, rules designed to open up broadcast white space should not have the unintended consequence of precluding use of that capacity.

There are many possible technical means to ensure that unlicensed devices do not cause excessive impacts on existing systems. The inputs – the specific approach used – are less important than the outputs – the degree to which customers of existing broadcasters experience performance degradation. In sparsely-populated rural areas, for example, precise mechanisms to verify the absence of other signals may be overkill. More generally, specific technical mandates are often too brittle. If companies can come up with innovative ways to achieve the goals the FCC sets forth, why should they be precluded from using those more efficient techniques?

No *ex ante* rules can ever be perfectly efficient at anticipating real-world scenarios. However, to the extent possible, the Commission should graduate its restrictions to limit the situations in which they are over- or under-restrictive. Some environments raise lesser concerns about harmful interference with licensed broadcast transmissions. These include rural areas, where there are fewer stations transmitting, and in-home use at low power, where the interference threat is limited to the person operating the unlicensed device. The Commission should attempt to identify categories such as these which could be subject to less stringent transmission restrictions for unlicensed devices.

A. Control Signals

In some cases, the specific mechanisms the FCC proposes may have perverse consequences. If, as proposed, portable devices are required to identify availability of spectrum by reference to an external “control signal,”¹⁶ what happens in rural areas where there is no broadcaster in the vicinity? Those are the situations in which the most white space is available, because there are no existing services that would be impacted. The FCC’s rules should make it easier, not harder, for unlicensed devices to operate in those areas.

There are other problems with the control signal regime. If, as the Commission proposes, transmission of such signals is voluntary, what happens in an area where, for whatever reason, no one chooses to transmit a signal? Moreover, inviting incumbent broadcasters to provide the control signals for unlicensed devices in the bands where they operate raises the specter of the fox guarding the henhouse. Broadcasters, who have consistently opposed the Commission’s plan to allow unlicensed devices in these bands, have little incentive to provide accurate control signals to enable those devices to operate.

Instead of requiring unlicensed devices to receive a control signal indicating channel availability before transmitting, the Commission could allow devices to operate unless

¹⁶ NPRM at 10.

they receive a control signal identifying that a channel is in use. Such as “permitted if not prohibited” approach would address many of the concerns raised above. It would also give broadcasters adequate incentives to transmit control signals.

As the NPRM itself notes,¹⁷ there are alternative means for an unlicensed device to determine whether a channel is available. These include relying on an internal or external database, using Global Positioning System or other location detection technology, and directly sensing for available channels, in the manner of a cognitive radio. Though the Commission may conclude that neither enjoys sufficient confidence yet, it should at a minimum allow equipment and service providers the opportunity to demonstrate that such alternative mechanisms work. If another approach is as effective as the control signal, an additional rulemaking proceeding should not be required to implement it.

B. Other Rules

The NPRM proposes other limitations including a maximum power output level of 100 milliwatts for portable devices and the 1 watt Part 15 limits for fixed devices, requirements regarding antenna gain, and a requirement to transmit a unique identifier code. These may well be reasonable “first cut” limits, in order to gain confidence that devices can operate appropriately. However, any arbitrary technical limit the Commission sets will be over-restrictive in some situations.

For example, the NPRM seeks comment on higher power limits for rural areas. Where distances are greater and other signals are less common, higher power limits would be appropriate. In-home use at low power, where transmissions are not likely to affect other users, may also warrant looser rules governing unlicensed devices. The Commission should develop some sort of waiver or modification process to take into account such environments. If equipment manufacturers know ahead of time that technical limits on

¹⁷ NPRM at 9-10.

their devices may be loosened in the appropriate circumstances, they will have incentives to make reasonable engineering tradeoffs in building flexibility directly into those devices.

The unique identification code is a reasonable mechanism to reduce enforcement costs, by linking signals to a particular device. However, the Commission should exercise care to ensure that such codes do not compromise the privacy or security of users. The personal computer industry has significant experience, both positive and negative, with unique identifier mechanisms. The Commission should seek input from industry and consumer groups involved in those discussions, to ensure that it does not repeat mistakes that can be anticipated.

C. Building in Flexibility From the Beginning

By adopting appropriate technical standards, regulators can ensure that new unlicensed devices do not create significant interference with existing broadcast services. It may make sense to establish more conservative restrictions at first, but to relax them as experience develops with device capabilities and usage patterns.

Focusing too hard on specific technical solutions creates a vicious circle. For example, the incumbent broadcasters' comments on the NOI include a study by Stuart Lipoff purporting to show that a flourishing unlicensed device market in broadcast white space is "economically impractical."¹⁸ Lipoff's rationale is that a "listen before talk" etiquette for devices is the best approach to address interference concerns, and implementing such an etiquette would more than double the cost of unlicensed devices.

Putting aside the technology industry's long track record of harnessing Moore's Law to reduce hardware costs as volumes increase, this is a case of the tail wagging the dog. A particular technical approach is postulated as the best solution, and that approach is then

¹⁸ See broadcaster comments, at attachment.

criticized. Even if Lipoff is correct, there is no inherent reason that “listen before talk” must be the means all unlicensed devices operating in low-frequencies employ to protect incumbent services. The best way to ensure that a flourishing market of unlicensed devices does not develop is to create incentives for bottom-up standards-development and compliance. The FCC has good experience on this point in the Unlicensed PCS bands. There, the Commission’s choice of a specific set of technical parameters, though well-intentioned, had the unintended consequence of killing the device market before it got started.

Again, this is not to say that there should not be rules. The FCC’s mission should be to develop the most minimal and flexible set of rules necessary to achieve its objectives.

One additional concept should be kept in mind. The fundamental unit of wireless communication is not radios, but radio systems. A network of devices, operating cooperatively, may be able to communicate effectively where a single transmitter and receiver cannot. This is because, as previously mentioned, devices can serve as relays for other devices, and because each device can apply intelligent processing to the signal it is attempting to send or receive. More devices, and more signals, also can provide additional information about local signal propagation. An intelligent device can make use of that information to distinguish signals from noise. Therefore, the Commission should craft its rules for devices operating in frequencies previously allocated to broadcasting to recognize that unlicensed systems may be able to use different mechanisms for protecting incumbent broadcast signals than individual devices.

VII. Benefits for Rural Areas

As mentioned previously, there is likely to be more available “white space” in rural than urban areas. Rural areas are also less likely to have competitive broadband providers, or even any affordable broadband option.

Many rural areas are already being served by wireless ISPs (WISPs) using a variety of licensed and unlicensed technologies. WiFi variants and 5 GHz systems, soon to fall under the WiMax umbrella, have been the primary solutions for this market in recent years. There are over 1,500 WISPs operating in the US today, according to Cahners In-Stat, many of them in rural areas serving anywhere from a handful to many thousand customers.

Lower-frequency unlicensed systems offer better propagation, meaning longer range and lower infrastructure costs. These benefits significantly improve WISP economics, especially if the improved propagation allows for user-installed customer premises equipment. Opening up broadcast white space could thus be a huge boon to rural communities struggling to obtain affordable, high-quality broadband access.

VIII. Conclusions

Adding more capacity is not a sidelight of spectrum policy; it should be the Commission's primary objective. With more competitive opportunities and more room for innovation, many of the scarcity-based concerns that bedevil the Commission's existing broadcast regulatory regime begin to evaporate.

There is some 400 MHz of capacity allocated to broadcast television – double that available for cellular (which generates more than double the annual revenues of broadcasting), and five times that available for WiFi and other devices in the 2.4 GHz unlicensed band. And it is in frequencies with particular benefits for applications where propagation through walls and other obstacles is important. Portions of that spectrum can easily be made available for unlicensed devices, without significantly detracting from existing broadcasters.

The Commission should certainly exercise care in implementation of its proposals. It should not waver in its commitment to a spectrum policy that best serves the interests of the American people.

Respectfully submitted,

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